

NOV 10 2005

PATENT  
Case No. N0154US**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Application of: )  
NARAYANAN ALWAR et al. )  
Serial No. 10/667,699 )  
Title: METHOD AND SYSTEM FOR )  
OBTAINING GRADE ROAD DATA )  
Filed: September 22, 2003 )


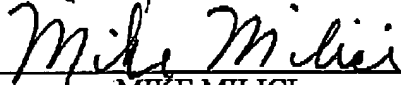
**DECLARATION UNDER 37 CFR 1.131**

The undersigned, NARAYANAN ALWAR and MIKE MILICI, each hereby declare that:

1. We are co-inventors of the invention described and claimed in the above-identified patent application.
2. Before March 4, 2003, we invented a new method for representing road grade data in a database. Part of this new method included, using a barometer associated with a vehicle traveling in a geographic region to collect altitude data, analyzing the collected altitude data to derive road grade data, and storing the data representing road grade in the database.
3. Before March 4, 2003, we prepared an Invention Disclosure Statement Form describing our invention. We filed the Invention Disclosure Statement Form with the Legal Department of the assignee of the subject patent application. A redacted copy of the Invention Disclosure Statement is attached hereto (Exhibit 1).
4. The section entitled "Detailed Description of Invention" beginning on page 1 of the attached Invention Disclosure Information Form discloses the elements of our invention recited in paragraph 2., above.

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5. All statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true, and further these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful statements may jeopardize the validity of the application or any patent issuing thereon.

  
\_\_\_\_\_  
NARAYANAN ALWAR  
  
\_\_\_\_\_  
MIKE MILICI

11/1/2005  
\_\_\_\_\_  
DATE  
Oct 27th 2005  
\_\_\_\_\_  
DATE

# Exhibit 1

# NAVIGATION TECHNOLOGIES CORPORATION INVENTION DISCLOSURE STATEMENT FORM

(Return electronic copy and  
fully executed hard copy to Legal Department)



(to be filled out by Legal Dept.)

Shorthand Name for Invention: Deriving Grade using Barometer

Developers Who Contributed to Invention:

1.	<u>Alwar Narayanan</u>	2.	<u>Mike Milici</u>
3.	_____	4.	_____
5.	_____	6.	_____
7.	_____	8.	_____

Date (or Month) on Which Development Began:	_____
If Known, First Date (if any) on Which Development was:	_____
(a) described in a CONFIDENTIAL document released outside of NTC	_____
(b) described in a CONFIDENTIAL conversation with a non-NTC employee	_____
(c) described in a NON-confidential document released outside of NTC	_____
(d) described in a NON-confidential conversation with a non-NTC employee	_____
(e) included in any version of a product released outside of NTC	_____
(f) used internally at NTC in the normal course of operations:	_____
(g) discussed at a Brainstorming Session for IDS No.	_____

## Summary of Invention:

Collecting altitude information to derive road grade has been one of the bigger challenges to NT for the past 1 1/2 years. Prior research in the industry claims that altitude from GPS (or DGPS) is not sufficient to derive high accuracy road grade under all conditions. Using DEMs from remote sensing are an expensive proposition to collect road grade. Further, the process changes required for using Remote Sensing for road grade are quite complex. The DEMs are placed only at fixed distance intervals which may or may not be on the road. Additional data processing is required for handling such nuances.

The approach proposed in this invention uses a standard off the shelf barometer to collect altitude. When this barometer is synchronized with DGPS position, a continuous height profile of the road on which the vehicle is moving can be obtained. Experiments show that the altitude from a barometer does not have large fluctuations and the data is always a true representation of the road height. While such an accuracy may not be necessary for NT purposes, software algorithms can be developed to smooth road undulations and derive a smooth height profile.

## Key Words for Invention:

barometer, road grade, altitude

## Advantages of Invention (to the extent known):

Simple, easy to deploy solution for deriving road grade. Data collection is transparent to the field staff and does not require any special training (plug and play).

Collecting data from mobile mapping eliminates the ambiguities that arise from remote sensing.

Unlike GPS altitude changes (loss of GPS, multipath), barometer altitude changes are not affected by the environmental conditions and are available at a constant rate.

As a mobile mapping solution, it does not depend on 3rd party sources. The data will be as old and as good as our 2-dimensional mobile mapping data.

## Detailed Description of Invention

- describe function(s) performed

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• describe with particularity the way in which each function is achieved (e.g., if the invention is a process, describe each step of the process):

Experiments were conducted using the Druck DPI 740 barometer. This barometer has an RS232C interface that was connected to the laptop. Standard GPS receiver that is used in the field today (Satloc/Omnistar) was used along with this barometer. Special data collection software was developed to collect the barometer data in synchronization with GPS data. The barometer data collection was made transparent to the field staff and avoids additional stress to collect road grade. Experiments were conducted to study the behavior of altitude changes from barometer under different operating conditions (Windows Open/Half-Open/Close, Air ON/OFF, Radio On/Off). Tests were also conducted to study the change in altitude under stationary conditions and driving at different speeds on the same road. Tests were also conducted for testing the repeatability.

It was observed that whenever the windows are open or the AIR is on, the altitude values from Barometer differs by a constant amount. However, it was noticed that NT field staff do not keep changing either the window position or the air setting continuously, while they are busy collecting data.

Data collected from these experiments indicate that barometer data has good repeatability and captures all variations of height profile along the road. The figures in the attached document illustrate the results from these experiments.

It is also felt that the curve fitting algorithms that are currently used for geometric representation should be useable for fitting altitude data also. Depending on the application requirements, road grade can be derived from this smooth profile.

To summarize, the barometer DPI 740 shows a lot of promise for deriving road grade from mobile mapping and is an easy to deploy solution.

Please place an "X" next to the appropriate statement:

☐ No design documents exist  
☒ The following design documents exist (and copies are attached): \_\_\_\_\_

Signature: \_\_\_\_\_  
(of preparer-developer)

Date: \_\_\_\_\_

Type Name: Alwar Narayanan

Signature(s) of Contributing Developers:

1. Name: _____	Date: _____
2. Name: _____	Date: _____
3. Name: _____	Date: _____
4. Name: _____	Date: _____
5. Name: _____	Date: _____
6. Name: _____	Date: _____
7. Name: _____	Date: _____

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